

Energy and the Cell



EQ: How do cells acquire energy?

EQ: Why is the relationship between plants and animals essential to life?



All living things need energy to survive and do work .

Organisms who depend on the sun to make their own nutrients are known as **autotrophs**, or "Self Producers."



Pull



Pull

Those organisms who must feed on other organisms to obtain energy are called **heterotrophs**.

These organisms share a symbiotic relationship that is dependent upon the creation of chemical energy that can be utilized by one another.

Animal cells harvest the energy stored in organic compounds, from foods taken in like carbohydrates, fats and proteins, and convert this into a usable form of energy.

This process is known as Cellular Respiration and happens in 3 steps:

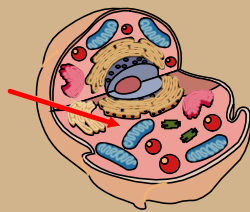
1: Glycolysis

2. Citric Acid or Krebs Cycle

3. Electron Transport Chain or oxidative phosphorylation



Click to reveal



Glycolysis

To make ATP, energy is slowly released by breaking down glucose.
Called Glycolysis or "*Sugar Breaking*"

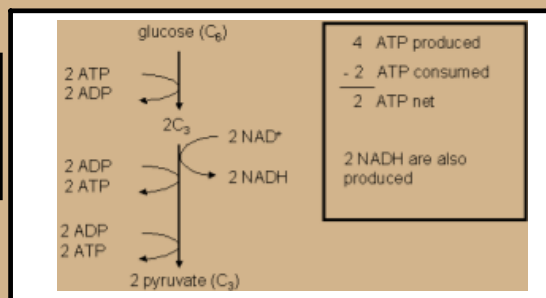
AND

Takes place in the Cytoplasm of the cell

Click the animal cell to reveal more info on Glycolysis

1

Products:
For each molecule of glucose, 2 pyruvate molecules are created.



Products:
A net gain of 2 ATP are produced during Glycolysis

2

Click the steps of Glycolysis to watch a video clip

After that Pyruvic Acid has 2 Choices...

» Anaerobic
Respiration
(aka
Fermentation)

[Click here for more info
on the Anerobic Pathway](#)

» Aerobic
Respiration

[Click here for more info
on the Aerobic Pathway](#)

Fermentation

[Click to reveal](#)

2 Types

Lactic Acid
Fermentation

Alcohol
Fermentation



Lactic Acid Fermentation

← Glucose → pyruvic acid → lactic acid + ATP



The build up of **lactic acid** in the muscles is what causes them to be **fatigued** and **sore**.

Lactic acid fermentation occurs in **muscle** cells during strenuous exercise when **a lot** of energy is required and **oxygen** is **scarce** (little to no oxygen)

Alcohol Fermentation

← Glucose → pyruvic acid → alcohol + CO₂ + ATP



Yeast and some **bacteria** cells are capable of alcoholic fermentation during which glucose is broken down to release **CO₂** and **ethyl alcohol**

The bubbles formed by the **CO₂** make **bread rise**
The alcohol released turns grape juice into **wine**

In the presence of Oxygen, the Pyruvate molecules created from Glycolysis will proceed through Aerobic Respiration

Takes place in the mitochondria

Click to reveal



CO₂ and Water are the "exhaust"

Organic molecules & Oxygen are the "fuel"



The main goal of Aerobic respiration is to create chemical energy that will be used for cellular work. These pathways use the electrons stored in organic molecules to create ATP.

Pull

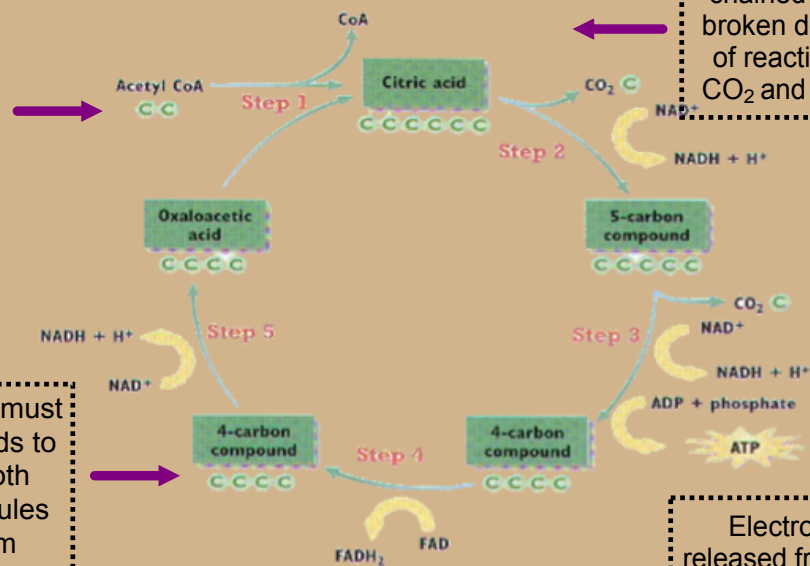
The Krebs Cycle

Pyruvic Acid is broken down to Acetyl CoA

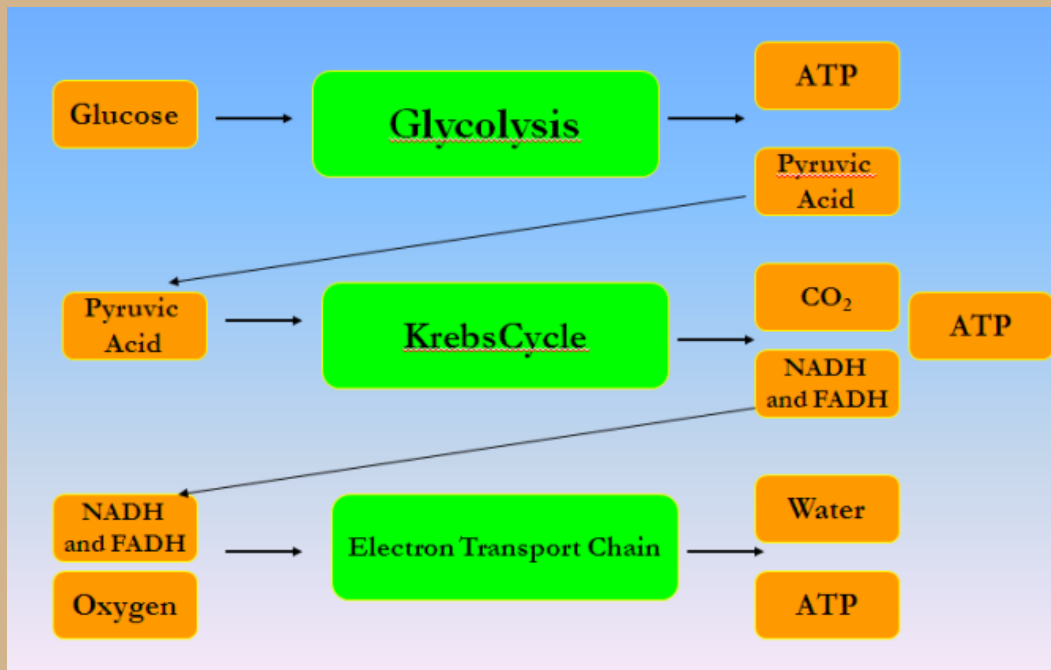
Along the way, Carbon chained molecules are broken down in a series of reactions, releasing CO₂ and Hydrogen Ions

The Krebs cycle must occur for 2 rounds to break down both Pyruvate molecules produced from Glycolysis

Electrons are released from carrier molecules, creating potential energy



Click the Krebs cycle for a short animation



Equation and Products of Aerobic Respiration



Glycolysis

Krebs Cycle

ETC

4 ATP Produced
- 2 ATP Consumed
2 ATP

2 ATP Produced

38 ATP Produced
- 2 ATP Consumed
36 ATP

= 40 TOTAL

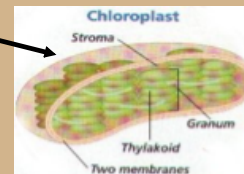
Plant cells harvest their energy from the sun and convert it into organic compounds.

This process is known as Photosynthesis and happens in 2 stages:

1. Light Dependent Reactions

2. Light Independent Reactions

Takes place in the chloroplast of a plant cell



Two Stages

Light Dependent



Needs light to occur

Light Independent



Does NOT need light to occur

What happens in the Light Dependent Reactions?

Chlorophyll absorbs energy from the sun and that energy is passed along the thylakoid.

1

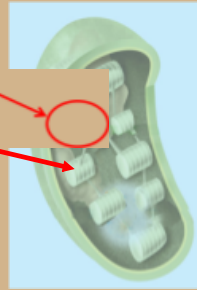
2 Energy from the sun "excites" the electrons in chlorophyll, causing water molecules to split in half and give off Oxygen (we breathe that oxygen).

The electrons produced then follow through an ETC.

3

4 Energy is transferred through the electron transport chain and result is ATP synthase (enzyme) = adds a phosphate to ADP to make ATP!

Grana
= Light



Light Independent: AKA The Calvin Cycle

While this system depends on the products from the light reactions, it does not directly require light energy. It uses the electrons and ATP from the Light Reactions to drive the Calvin Cycle.

1

2 Carbon dioxide is absorbed from the environment and then split, providing carbon to make sugars.

The ultimate product is glucose.

3

Stroma: = Light independent reaction



Products of each phase of Photosynthesis

Light Dependent:



Makes high
energy
molecules and
ATP

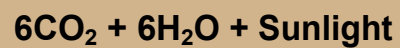
Light Independent:



Makes a usable
form of energy
for the plant...
sugar

Equation and Products of Photosynthesis

REACTANTS



PRODUCTS



Click the image for an animation on Photosynthesis



What do plants do at night?
Remember Plants have both



?

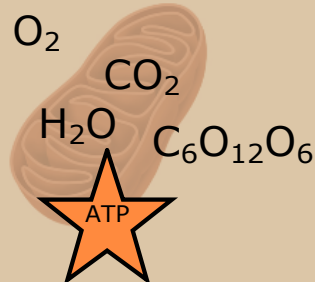
What does this imply for a plant's energy production when there is NO sunlight?

Check Your Understanding:

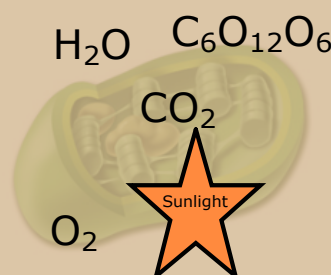
Reactants

Products

Respiration:

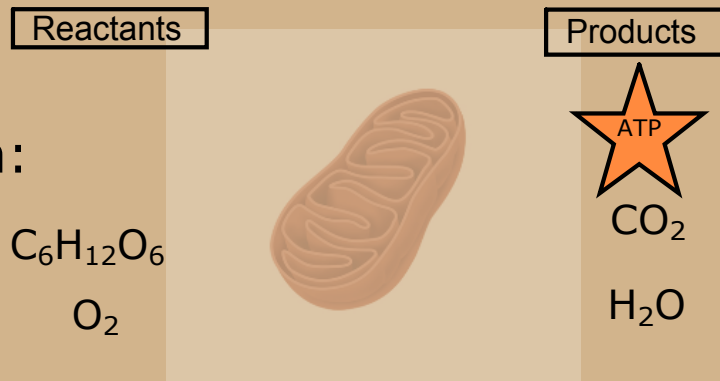


Photosynthesis:



Check Your Understanding:

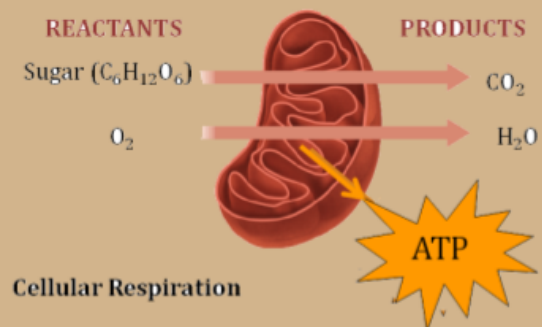
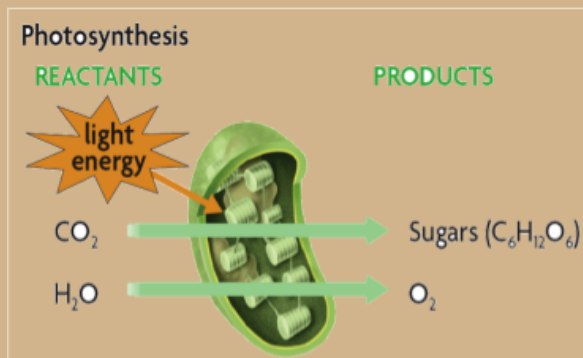
Respiration:



Photosynthesis:



Can you observe any similarities in the reactions below?



Click to Reveal

Comparing Both Cycles

Click the shades to reveal answers

	Respiration	Photosynthesis
Where does it happen?	Mitochondria (Animal and Plant Cells)	Chloroplast (Plant Cells Only)
Reactants	$C_6H_{12}O_6 + 6O_2$	$6H_2O + 6CO_2 + (\text{sunlight})$
Products	$6H_2O + 6CO_2 + (\text{ATP})$	$C_6H_{12}O_6 + 6O_2$

The relationship between the processes of Respiration and Photosynthesis allow energy, in the form of organic nutrients, to flow through ecosystems.

The sun provides the original source of energy that initiates the flow of energy.



Energy not used is lost in the form of heat and waste.

Click on the diagram for more info.

